Agrarian Change in the Central Plain of Thailand (1950 - 2020): A Longitudinal Study of Farm Characteristics

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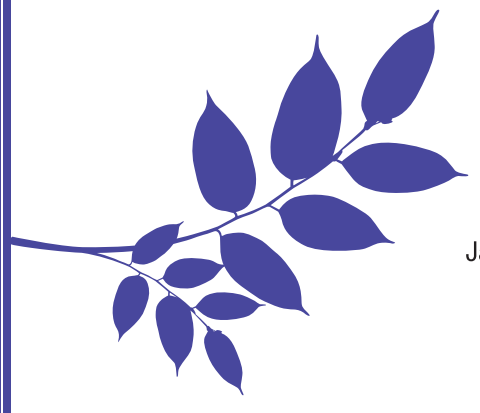

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1 Introduction

The Chao Phraya Delta, or Central Plain(s), is known as the 'rice bowl of Thailand', having been the historical heart of the country's large-scale rice production and export. Commonly linked to the 1852 signing of the Bowring Treaty between Siam and Great Britain, which opened the country to world markets, the history of rice production in the Central Plain has been the subject of many seminal academic works (see among others Seksan, 1989; Ingram, 1971; Johnson, 1974; Feeny, 1982). The 1950s saw a research project examine social and economic changes in Bang Chang, a village outside Bangkok (see Janlekha, 1955 and Hanks, 1972). In the 1970s pioneering work was carried out by Japanese researchers, notably at Kyoto University, on environmental conditions and agricultural development (e.g. Takaya, 1986; Kaida, 1974), as well as historical and anthropological factors (e.g. Ishi, 1978; Tanabe, 1980; Tomosugi, 1980). In the 1980s agricultural transformations were analyzed from a Marxian perspective with an emphasis on commercialized production, tenancy and landlessness (e.g. Mehl, 1981; Chiengkul, 1983; Douglass, 1984). While research carried out at Kasetsart University in the 1990s documented agrarian change and water management in the delta (see Molle and Srijantr, 2003; Molle et al., 1999a, 1999b). Perhaps because its share of Thailand's rice production gradually declined to around 20%, few studies have documented agricultural change in the Chao Phraya Delta in the past 20 years. Yet, urbanization has steadily encroached upon the delta, seeing agricultural land shrink by approximately a third since 1963, and it has had to increasingly share the water resources of the Bhumipol and Sirikit dams with upstream areas and urban populations. Farmers are known to be ageing, as in the rest of Thailand, and have had to embrace diversified livelihoods (Rigg, 2019), while younger generations have largely walked away from farming (Rigg et al., 2008; Bhuchongkul, 1985).

The present article attempts to fill this knowledge gap by analyzing data on evolving farming structures over the past 70 years. Data from the agricultural censuses of 1950, 1978, 1993, 2003 and 2013 allow us to link past studies with the transformations that have taken place in the past two decades. We also refer to a variety of other surveys and data (population censuses, labor surveys, Statistical Yearbooks), as well as the academic literature, to draw a picture of agricultural change in the Chao Phraya Delta. We proceed in two steps: first we present tabular data that describe the main features of farm holdings regarding family members, land use, labor, land tenure, indebtedness. To avoid the significant bias from considering the aggregated data available for the Central Region[1] we have tabulated, combined and compared data at the province (*jangwat*) or district (*amphoe*) levels. We leave aside the coastal provinces that are increasingly incorporated into the neighboring Bangkok Metropolitan Area (BMA) to focus on the seven agricultural provinces of Pathum Thani, Ayutthaya, Ang Thong, Singburi, Chai Nat, Nakhon Pathom and Suphan Buri,[2] which we term the 'core delta'. For certain variables it was

[1] The Central Region includes the provinces of Trat, Rayong, Chon Buri and Chanthaburi to the east and Phetburi and Prachuap Khiri Khan to the west that are less populated and mainly rain-fed. Thus, data for the Central Region as a whole incorporates those from very different provinces.

[2] Suphan Buri was retained because of its importance in the delta, despite the fact that roughly 40% of the province lies outside the (irrigated) delta proper.

possible to map data at the amphoe level, after selecting the 103 amphoes that best match the irrigated Chao Phraya Delta (BMA excluded). We then move to a contextual interpretation of the data and attempt to tease out the most salient features of agrarian change in the delta. We are often led to disaggregate data at the jangwat level in order to reveal and explain opposing dynamics that can cancel one another out when aggregated at the (core) delta level. Thus, we intend to shed light on 1) the heterogeneity inherent in the delta and the roots of this, 2) the challenges facing irrigated agriculture in general in Thailand and its relative demise in the delta in particular. Our results are likely to foreshadow, or resonate with, changes observed in other Asian deltas, such as the Pearl Delta in China, the Red River and Mekong deltas in Vietnam and the Irrawaddy Delta in Myanmar.

2 Structural change in agricultural holdings

2.1 Number and size of holdings

The first dynamic aspect of agricultural holdings is their size and number. Agrarian change is strongly driven by associated population changes, in general, and inheritance rules and practices in particular. The larger the number of children inheriting land the faster it will be divided and fragmented. The resulting increase in the number of farm holdings is counterbalanced by the sale of land for non-agricultural use. In the core delta (Figure 1) the number of farms increased to almost 230,000 around 1993, before declining as the rate of land sales superseded that of the division of holdings. Since the total farm area also started to shrink after 1963 the average farm size declined from 29 rai in 1950 to 20.7 rai in 2013 (-29%). Yet the number of farms has not dramatically changed in the past 60 years (a drop of 12% from the 1963 value), although the 2013 census pointed to the disappearance of close to 30,000 farms in just 10 years. This drop in the number of farms can be contrasted with the growing trend observed at the national level (Rigg et al., 2018), which can be partly explained by the larger loss of land in the delta due to urbanization.

Figure 2 and Figure 3 show the absolute and relative changes in the number of farms by size: farms over 40 rai have decreased overall since 1978, while very small farms increased until 2003. Farms under 20 rai made up 39% of the farms in 1950 against 58% in 2013. The increase until 2003 in the number of large farms (over 140 rai) is noteworthy for signaling the consolidation of agrarian land. The absence of such a transition, that is on the contrary observed in many parts of the world, is the object of debate (Rigg et al., 2018). This trend was partially reversed between 2003 and 2013, suggesting that the larger farms comprised a significant proportion of leased land that the owners later decided to farm themselves (due to high rice prices). Disparities by the size of farm, notably the growth in holdings under 6 rai, saw the Gini index increase from 0.31 in 1950 to 0.56 in 2003 (later dropping to 0.50), representing growing inequity in the distribution of land.

By evidencing the changes in farm size (in terms of both number and total area of holdings) Figure 4 illustrates the fact that while medium and large farms declined during the 1993-2003 period, and small farms under 2 rai increased by around 18,000 units, the latest decade (2003-2013) witnessed a decrease in all size classes (most notably farms under 6 rai lost 20,000 units), except the 20-40 medium range due to the fragmentation of farms in the 60-140-rai bracket and above.

Figure 1: Total number and area of farms in the core delta (6 jangwat)

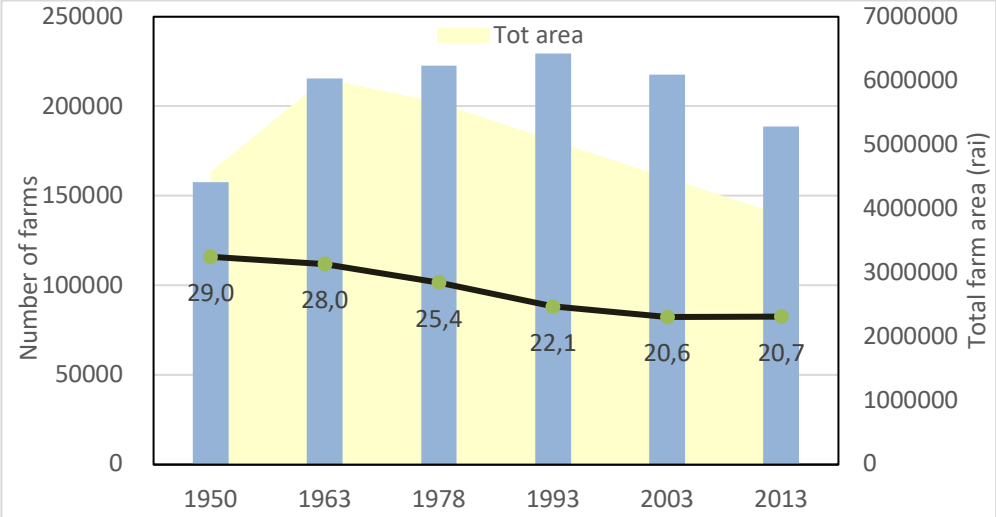


Figure 2. Evolution of total farms, by size class

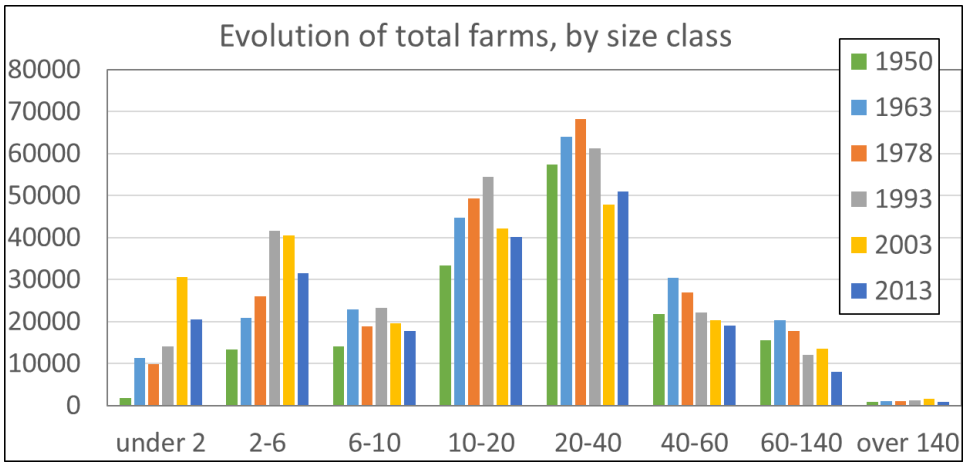


Figure 3. Evolution of total farms, by size class expressed as percentage

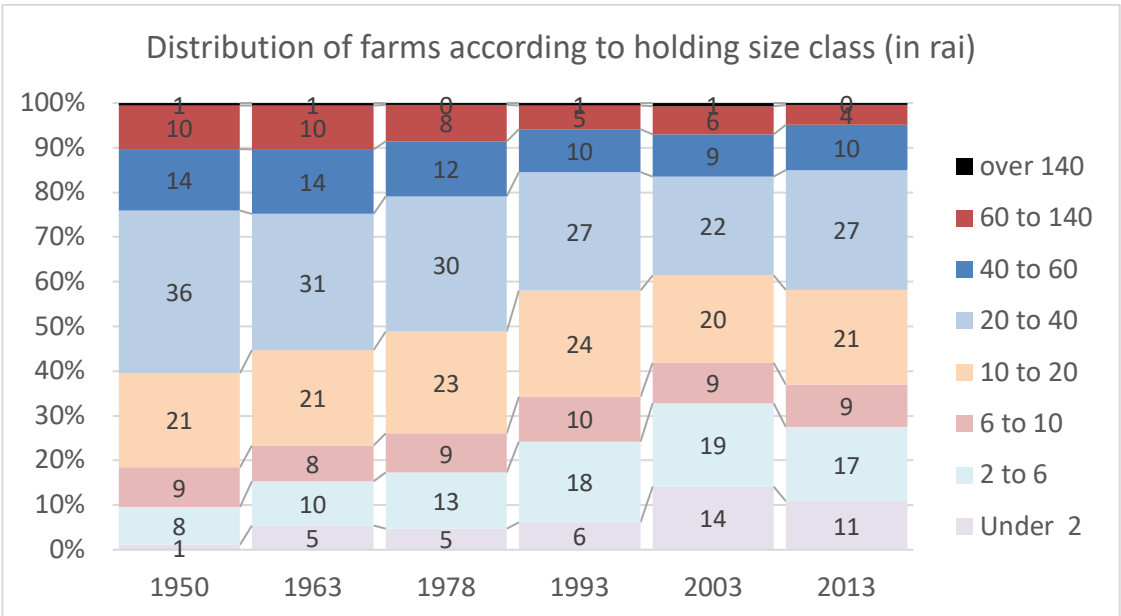
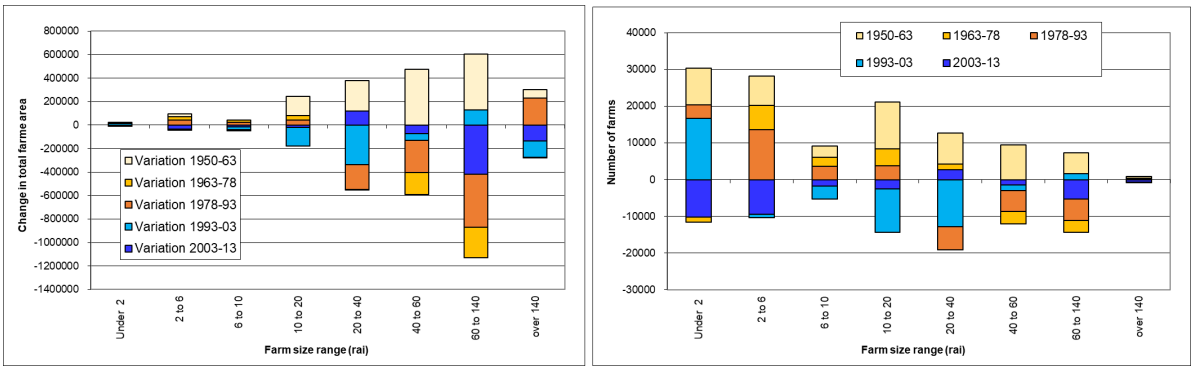


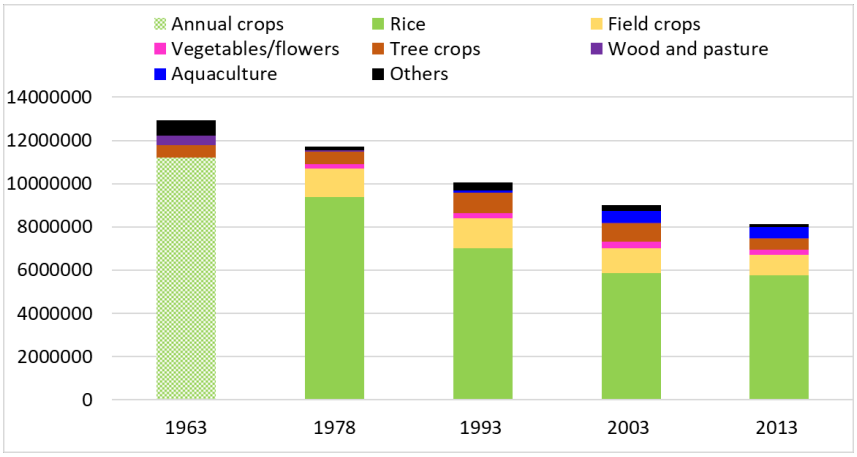
Figure 4: Evolution of farm size class, by farm number and total area (various censuses)



Farm-level land endowment cannot be taken as a proxy of wealth, although there is a degree of correlation. Large plots in single deep-water rice cropping, for example, illustrate the need to farm larger areas to ensure a minimal income (Molle et al., 2001b), whereas intensive farming, such as orchids and other flowers, aquaculture, or even vegetables in general, can yield substantial returns on limited land. The increased number of small farms actually reflects such diversification better than the extreme division of land, because no one can live on a small rice plot, even double cropped, without other sources of income.[3] This means that economically unviable farms signal (often old) farmers who continue to cultivate while receiving remittances from their children or other revenue.

Figure 5 shows that across the entire irrigated delta (twice the farmed area of the core delta), diversification had reached almost a third of the cultivated land by 2003, having accounted for less than 5% in 1963, before contracting again.

Figure 5: Evolution of land use in the Chao Phraya Delta (aggregated amphoe-level data)



Land (and farm) productivity is closely linked to the intensity of rice cropping. The growth in double cropping since the late 1970s has been remarkable, limited only by the availability of water in the dry season. Where access to water is good, with supplemental sources such as shallow aquifers, natural ponds (*bung*) or the rivers themselves, triple rice cropping can be observed. Molle et al. (2001b) have compared three villages in the delta with rice cropping intensities of 1, 1.5 and 2.2 respectively, showing how water conditions governed farm income and the need for financial diversification.

[3] It is hard to determine the minimum size of a viable rice farm because income will depend, among other things, on land tenure, the amount of farm labor used and the price of rice. The last two agricultural censuses failed to present data on 'rice-only farms', as in preceding ones, making it impossible to single out this category.

2.2 Demographic profiles

The evolution of farming systems is largely governed by population change. The most relevant demographic features include the fertility rate (average number of children per woman) and mobility (migration). Thailand has witnessed a spectacular drop in its fertility rate, from 6.1 in the post-WWII period to around 1.5 at present – far below the reproduction rate of 2.1 needed to ensure a stable population. As a result of this decline, along with outmigration, the number of holding members dropped from 5.1 in 1978 to 3.2 in 2013. Figure 6 shows the evolution in holdings by size (number of household members) and illustrates the growth in holdings with 3 members or fewer, against the gradual decline in those with 4 members or more. Figure 7 evidences that small farms have close to 3 members on average, while large ones have 4 members or more. Large farms have the capacity to absorb more family labor and also provide a more attractive economic prospect to heirs.

Figure 6: Number of holding members (last four censuses)

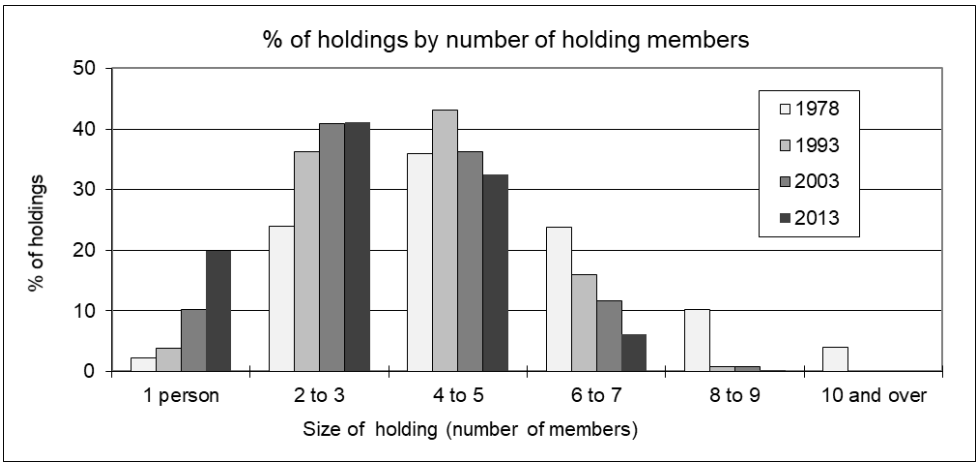
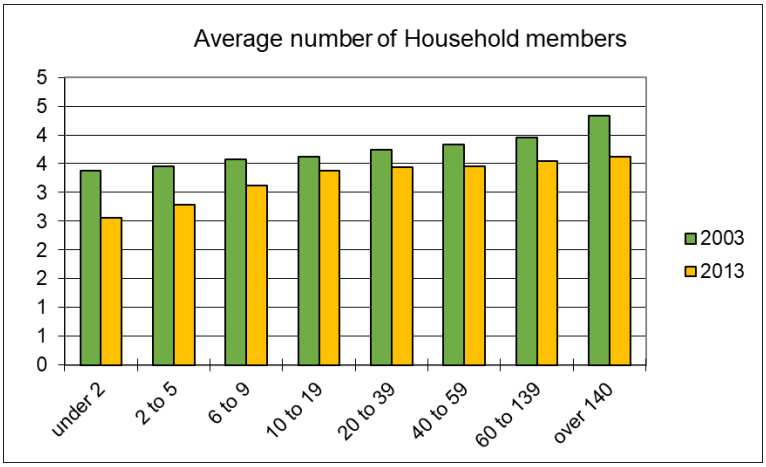
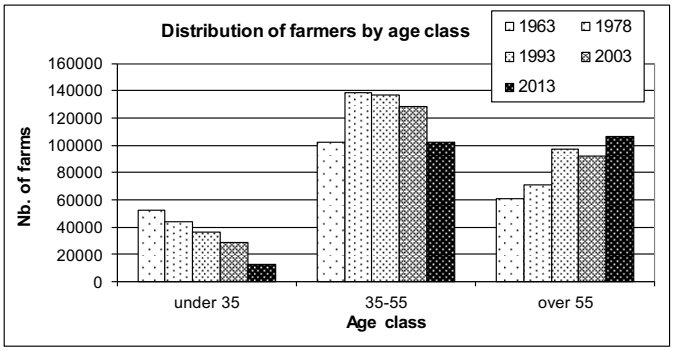


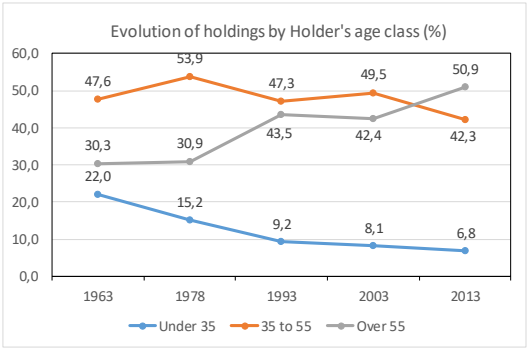
Figure 7: Average number of household members (by holding size)



As a result of the outmigration of (fewer) offspring to the agricultural frontier or other forms of economic activity (locally or in larger cities), the average age of farm owners has increased substantially – from 47 in 1978 to close to 54 in 2013. Figure 8 (right) further reveals that the heads of holdings under 35 years old only make 6.8% of the total, and more than half were over 55 years of age in 2013 (with 20% being over 65 years old).

Figure 8: Distribution of holdings by holder age class in absolute and relative terms (various censuses)



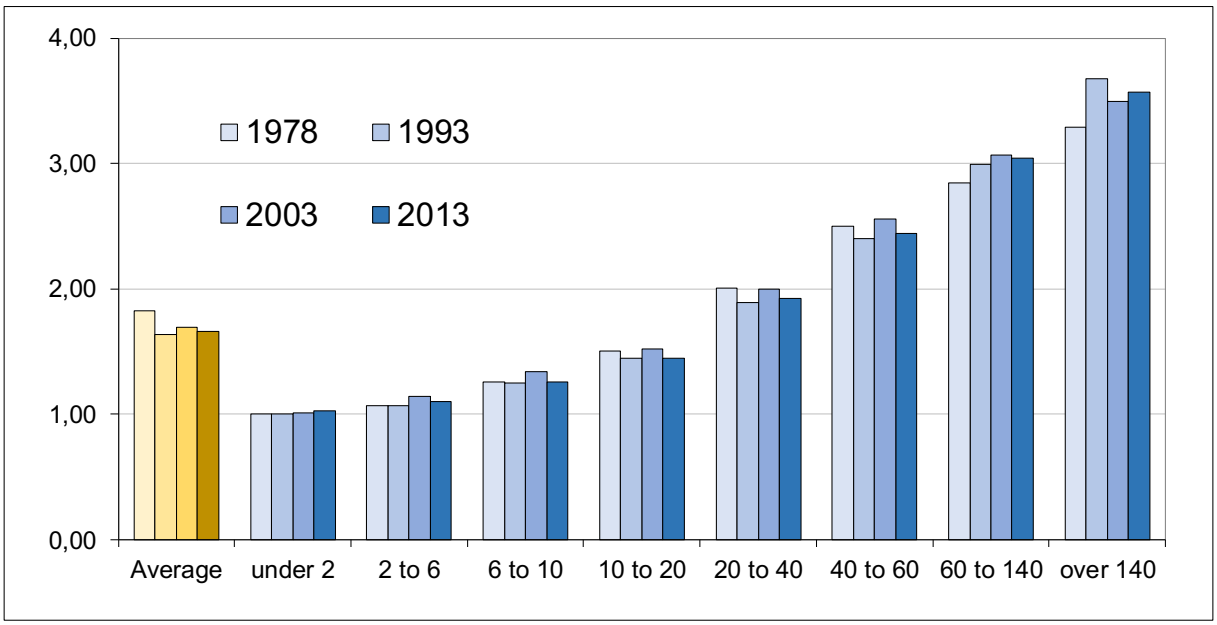


2.3 Number of plots

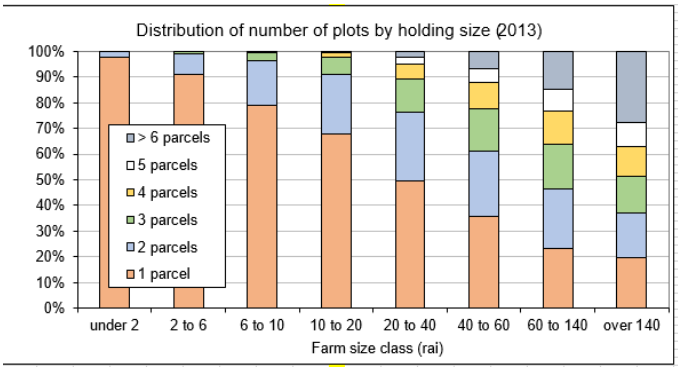
The inheritance of land by children in equal proportions, as is common in Thai tradition (along with the joining of plots upon marriage), results in the fragmentation of holdings – a familiar problem whereby land is divided into smaller, and often scattered, plots. Dispersion can also be accentuated by the leasing of additional plots of land.

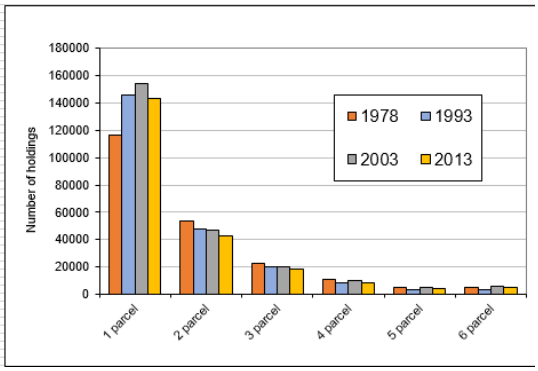
Remarkably, however, Figure 9 indicates that the average number of farm plots has remained stable since 1978, at a value of around 1.75. As expected, the number of plots per holding correlates with the size of the farm, with those over 60 rai having an average of 3 plots or more (but more than 5 plots in 25% of the cases). One explanation is that fragmentation by inheritance has been mitigated by the need to adapt this custom precisely to maintain viable holdings for the child agreeing to take over the farm.[4] Fragmentation has also been controlled by the sheer reduction in the number of children per family. Last, even when land has been split among children it is observed that those who do not engage in agriculture frequently cede their plots to those, if any, who take over the farm (either freely or with some form of compensation in kind, e.g. rice bags or cash) (Molle and Srijantr, 1999).

Figure 9: Average number of parcels by size of holding (rai)



[4] One child may inherit the land and the others the house or cash, according to the family situation.





2.4 Land tenure

As land is split up and farm sizes dwindle, additional agricultural plots can be bought on the land market. The price of land in the delta, however, has become so high that it usually no longer makes sense to buy it solely for agricultural production (around half a million baht per rai). Farmland is therefore obtained through lease arrangements that are generally on a monetary basis. (Payments in kind, such as a share of the production, gradually disappeared in the 1970s and 1980s; see Molle and Srijantr, 1999.)

Figure 10 shows that around 37% of the land area was leased out until the 1990s and that this subsequently rose to around 50%. In part this reflects the growing number of holdings with no family members prepared to take over from retiring farmers, freeing agricultural land for others wishing to expand cultivation in order to become economically viable. The percentage of 'full tenants' (those cultivating rented plots while owning no land) fluctuated between 20% in 1963 and 27% in 2013. Importantly, Figure 11 shows that the growth between 2003 and 2013 was concentrated on farms larger than 20 rai, suggesting that some landless farmers (or with small plots) are able to rent enough land to reach an economically viable level, despite (or perhaps, because of) the rent they pay to land owners. The origin of these full tenants is an important question, since it is possible that they were forced to sell their own farm due to debt. We will return to this issue.

Figure 10: Changes in tenancy: percentage of farmland that is rented

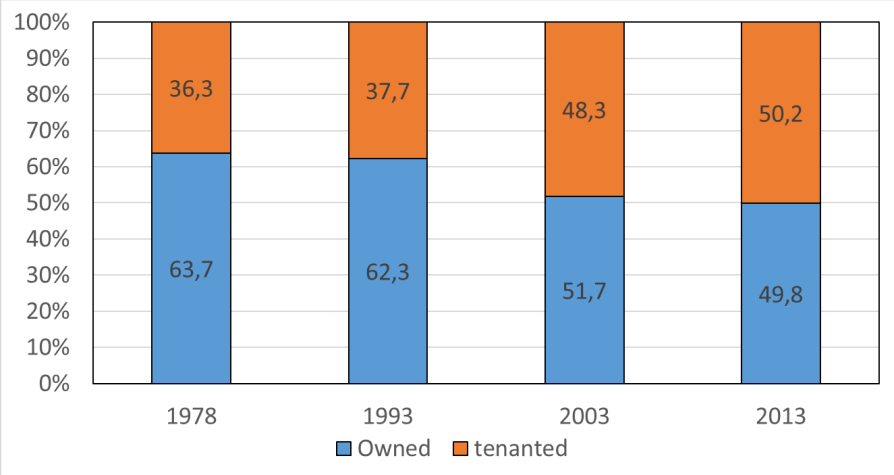
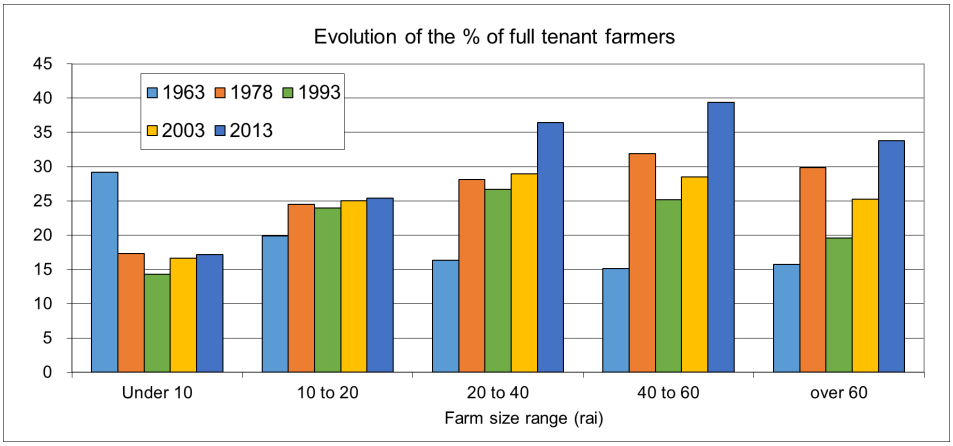


Figure 11: Changes in tenancy: percentage of full tenants



2.5 Family and wage labor

The sheer reduction in holding membership has a bearing on the labor force available for farm operations, exacerbated by higher cropping intensity, despite a drop in the average farm area. The response is an expansion of the wage labor market and mechanization. Figure 12 shows, however, that the employment of permanent labor has remained minimal, at only 2%-3%, since (at least) 1978, and that the use of occasional wage labor has also historically hovered around 55%, with a drop observed in 2003 (50.7%). Unsurprisingly, hired labor is chiefly found on larger farms, averaging above 60% for those above 10 rai and 75% for those over 60 rai. This shows that resorting to wage labor is very common. It can be seen that, unlike in later years, 1978 saw a more systematic use of hired labor on large farms while it was less common on small farms. This can be explained by the fact that, at that time, larger families on smallholdings had no need for labor from outside the household, and that mechanization was not yet widespread. Indeed, while the percentage of farms resorting to non-family labor remained roughly in the 40%-47% bracket, the reasons for this have changed over time. In the early days it reflected a lack of mechanization and the prevalence of transplanting, while today non-family labor is more related to ageing farmers no longer wanting, or being unable, to carry out certain tasks. For example, spraying pesticide is frequently contracted out.

Figure 12: Percentage of farms resorting to wage or permanent labor (total and size class)

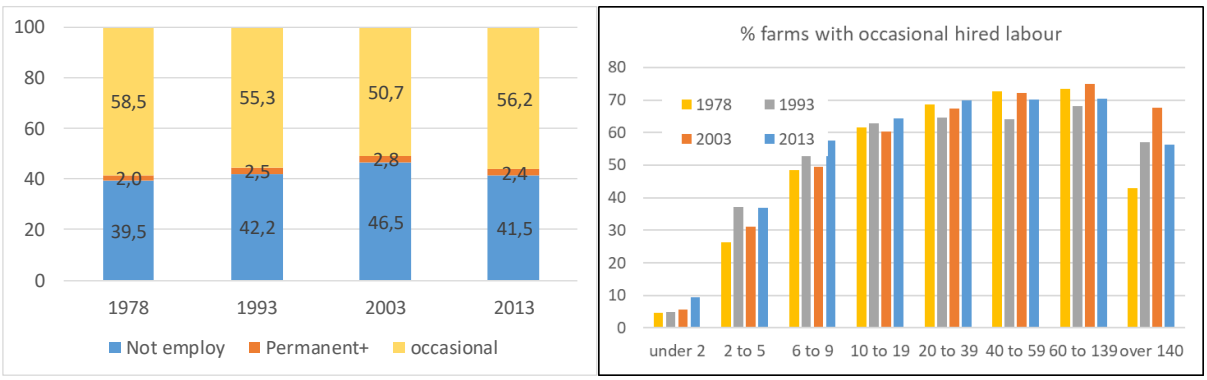
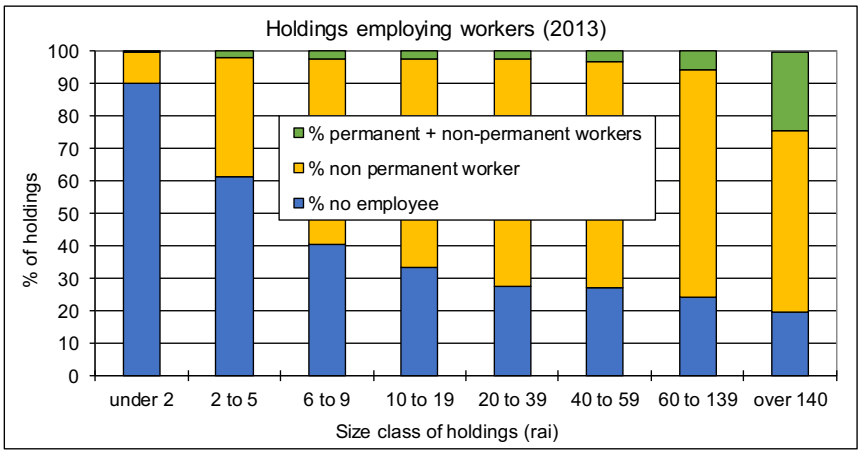


Figure 13: Percentage of farms resorting to wage or permanent labor (by size class; 2013)



Occasional labor can come from landless households or smaller farms that may have spare laborers that they make available on the wage market. Figure 14 indicates that 73% of the holders were only engaged on their own farm in 2013 against 64% ten years earlier. Another 18% are *mainly* engaged on their holding and provide additional labor force to other farms (plus 9% who are 'mainly engaged in other, non-agricultural work'). Figure 15 classifies this information by the size of the holding. Unsurprisingly, large holders are more likely only to be engaged on their holding (81%), while small farms are more likely to provide wage labor. Interestingly, while the data for 1993 and 2013 are comparable, those for 2003 show that larger farms were 'mainly' engaged on their own holdings. This indicates that farms over 10 rai diversified their income by working on other farms or in other sectors, which, as we will see later, reflects the poor profitability of rice after the turn of the century.

Figure 14: Classification of holdings based on the main economic activity of the holder

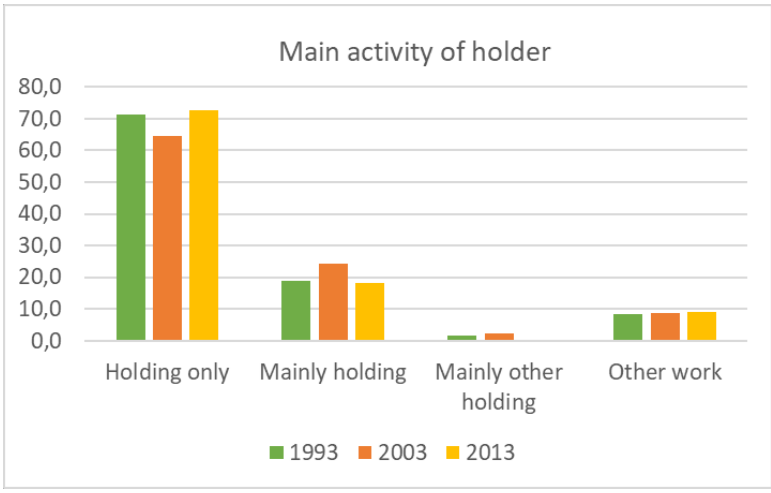
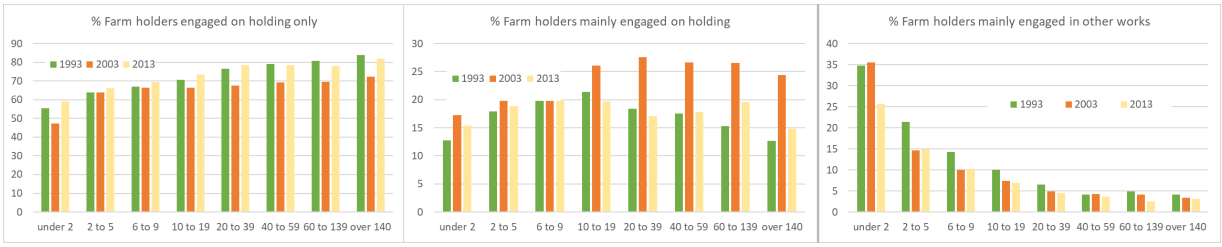
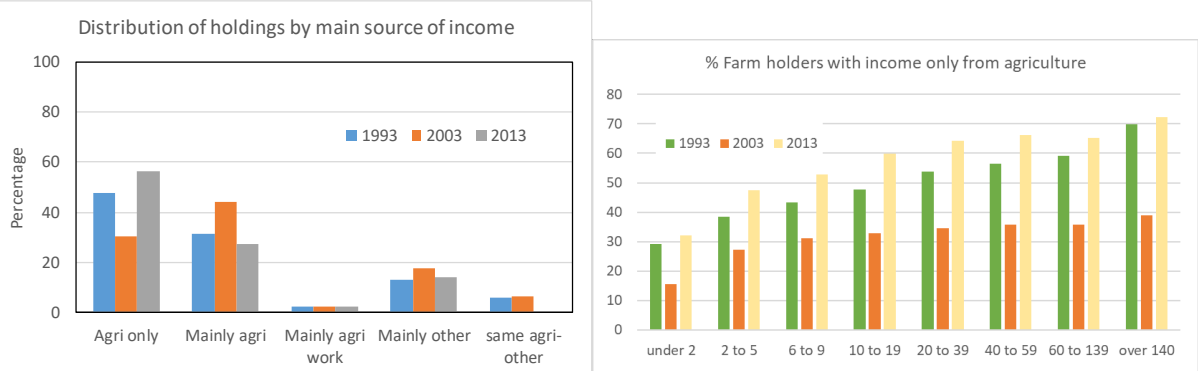


Figure 15: Main economic activity of holder, by farm size



The data above refer to 'engagement' (that is, roughly, in terms of time allocation). Figure 16 provides complementary information by showing that, in terms of income, in 2003 around 15% of farms shifted from the category 'agricultural income only' to 'mainly agricultural income', indicating that they diversified out of agriculture – a phenomenon that appears to have been reversed in 2013. In that year 57% of farmers drew their income exclusively, and 27% mainly, from agriculture. While the figures drop for smaller farms they remain high in relation to other regions of Thailand, showing that farming in the delta can still provide a basic livelihood for those choosing to remain in the sector.

Figure 16: Distribution of holdings by main source of income



Agricultural censuses only look at 'agricultural holdings', that is, families that have an agricultural activity of their own. As we have seen, there is a degree of reallocation of the labor force across these holdings, but it may also be the case that a substantial part of the labor force consists of workers relying on daily wages as an income. In agrarian studies, a key question is whether the labor force is constituted of former farmers who have become landless as a result of debt, linked, in particular, to the commercialization of agriculture and growing reliance on the market. This question was particularly debated in the 1980s by authors such as Chiengkul and Douglass, who identified a phenomenon of smallholder eviction. Molle and Srijantr (1999) examined the evidence available over a longer period of time and showed that the percentage of full tenants had in fact remained remarkably stable. It is difficult to fully account for these evictions based on the information available, but, unlike countries where it fueled increasing rural poverty, Thailand's industrialization offered landless farmers financial alternatives. This largely avoided social inequality, landlordism and the formation of an ever-growing rural landless proletariat.

Further insight into labor availability in the agricultural sector can be found in quarterly labor surveys. Figure 17 displays the distribution of employees in the agricultural sector (Central Region, Bangkok excluded; January-March[5]) according to the hours worked per week. The solid line also shows the percentage of people declaring their availability for more work, which is now close to zero, suggesting that surplus labor has been absorbed by other economic sectors over the past two decades. Figure 18 confirms that agricultural wages are lower than in manufacturing and construction in non-municipal areas and are less than half those in Bangkok's construction sector. This suggests a strong 'pull' from other sectors.

[5] Data before 2000 are given for non-municipal areas, while data after 2000 include both municipal and non-municipal. This introduces a small bias.

Figure 17: Distribution of employees in the agricultural sector, by number of hours worked per week (first quarter of the year)

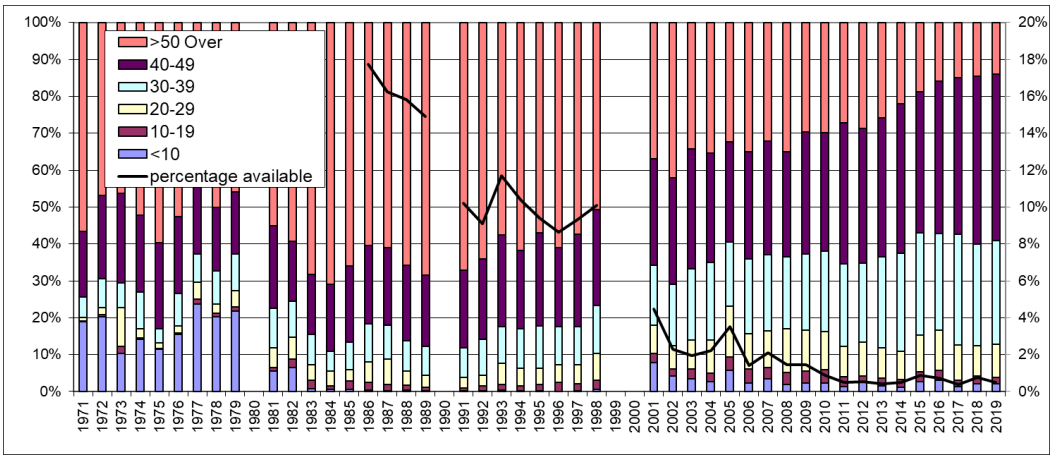
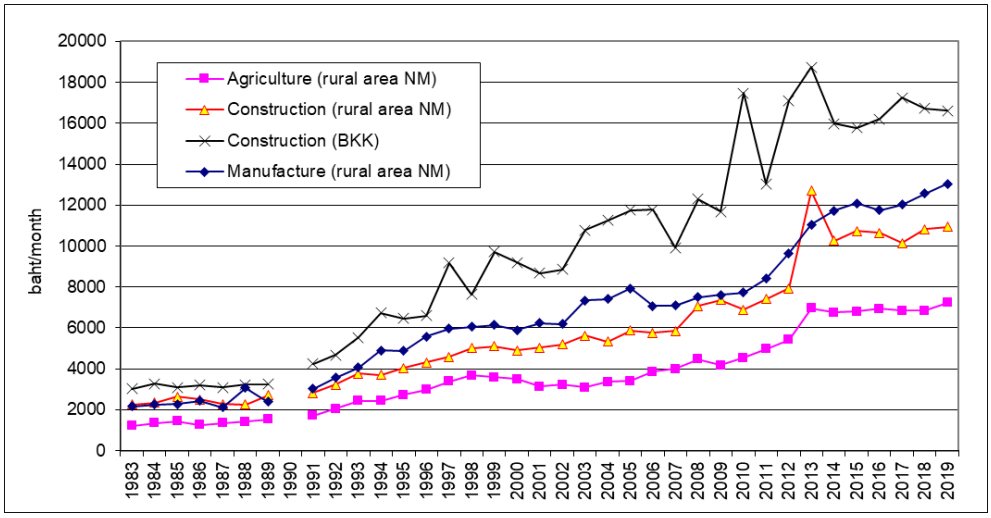


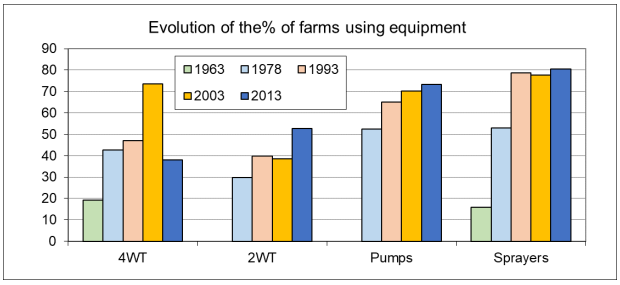
Figure 18: Average monthly salary for men in various industries (first quarter of the year)

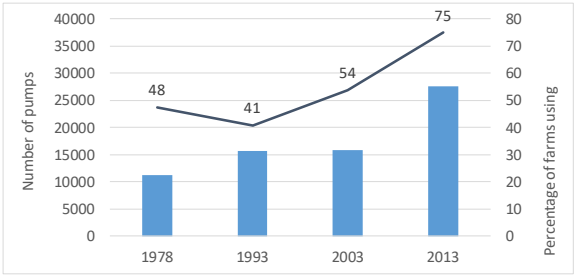


2.6 Farm equipment

The level of farm mechanization and equipment can be considered relatively high in the delta. Two- and four-wheel tractors have long replaced buffalo; combine harvesters are available for rice and sugar cane crops, and three farmers out of four have (mostly axial) pumps to ease access to water and/or drainage. As transplanting has been replaced by the direct sowing of pre-germinated seed, labor costs have dramatically fallen. Farms without tractors (often aged farmers or absentee owners) contract out soil preparation work.

Figure 19: Use of farm equipment (core delta)

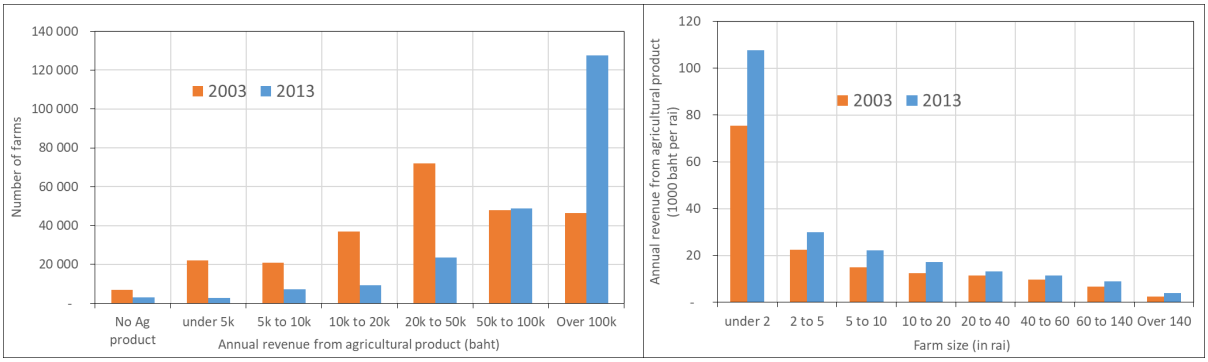




2.7 Average agricultural income

The distribution of revenue derived from agricultural product (not to be assimilated into the total revenue) is provided for the 2003 and 2013 censuses. Figure 20 (left) shows that farming income was extremely depressed circa 2003 in contrast to the boom that occurred around 2013,[6] again illustrating the spectacular impact of rice farm gate prices on rural income.[7] The figure to the right strikingly confirms that productivity decreases with farm size. Small farms under 2 rai include many cash crops and therefore produce far higher revenue. Some larger farms are located in low-productivity, single deep-water rice areas, generating a disparity across size ranges.

Figure 20: Annual revenue from agricultural product (2013 values): number of farms per range (left) and value per rai (right)



2.8 Levels of debt

As recorded in the last three censuses, debt may provide insight into the sustainability of agriculture. However, it is often hard to distinguish between productive investment, consumption loans and the forced borrowing of cash to ease financial difficulty. Figure 21 (left) indicates that debt is more common for large than small farms, although the difference was levelled out in the 2013 census. Almost 200,000 farmers in the core delta were in debt in 2003 for a total of 14 billion baht (approximately 337 million US$, 2003 values), meaning that the average farm debt was around 3,610 US$. Yet this obscures significant variation, since large farms have disproportionate debt compared with small farms (Figure 21, right). Farms over 140 rai averaged over 2 million baht of debt in 1993 and around 1 million in the two ensuing censuses. It is likely that this represents investment loans, for example, for rice harvesters, rather than delayed bankruptcy. We may also observe that while the number of indebted farms in 2013 was almost half of the 2003 value, the total debt was not reduced proportionally. The average debt per indebted farm was therefore 44% higher than 10 years earlier (in deflated 2013 values).

The Bank of Agriculture and Agricultural Co-operatives (BAAC) is the largest provider of loans to farms (Figure 22), while village funds, relatives or money lenders are generally used for smaller amounts (Figure 23).

[6] Agricultural revenue is expressed in 2013 values; hence, revenue ranges for 2003 have also been expressed in 2013 values and the corresponding number of farms estimated by interpolation.

[7] This also serves to caution against analyzing census data as if they were indicative of long-term trends, without duly factoring in the specific circumstances of census years.

Figure 21: Percentage of holdings in debt (3 censuses)

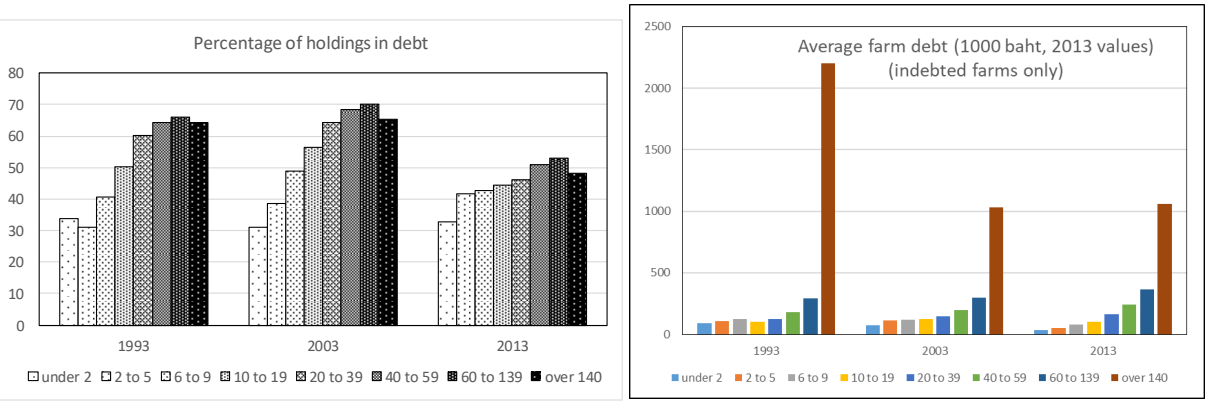


Figure 22: Number of farmers in debt and total amount of debt, by source of borrowing (core delta)

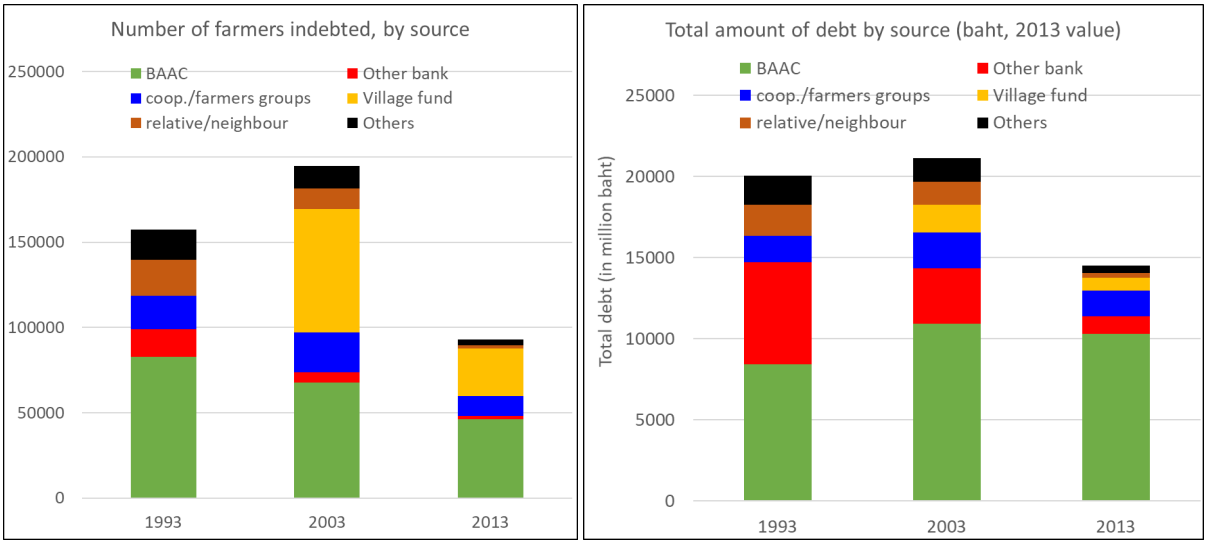
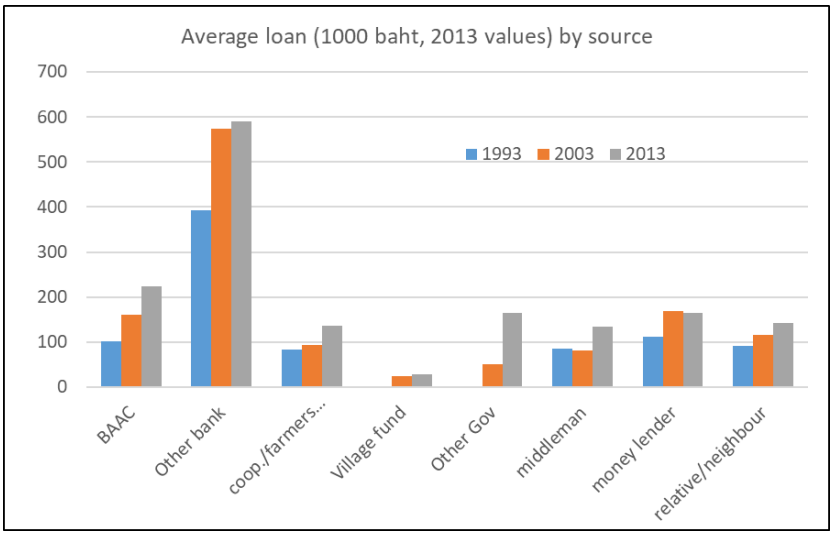


Figure 23: Average loan for different sources (2013 value), core delta



3 Contextualising and interpreting data

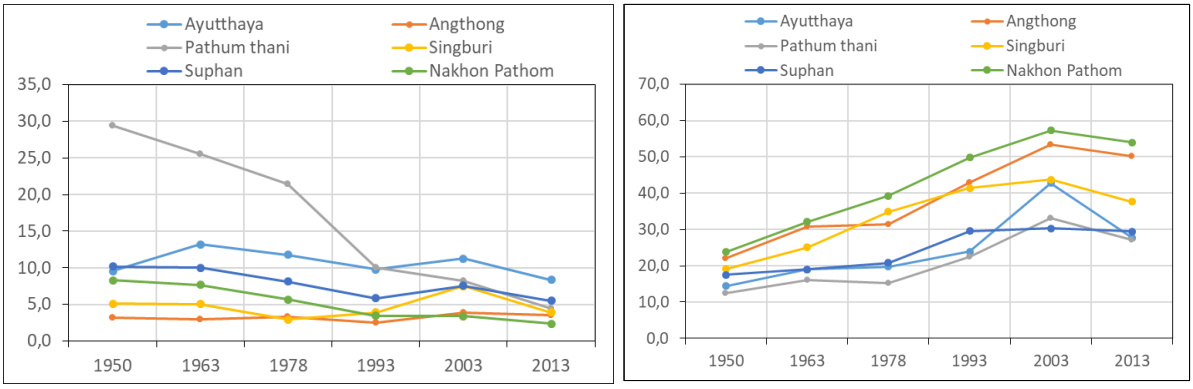
This breakdown of information allows us to draw an overall picture of structural change in the agricultural sector of the Chao Phraya Delta. In this section we attempt to join these different pieces of the jigsaw while disaggregating data at the jangwat level in order to identify the differences that suggest causalities and thus help us interpret the data.

A broad description of agrarian change in the Chao Phraya Delta, focusing on the 7 jangwat of the core delta, shows that agrarian space has contracted by 35% since the mid-1960s due to urbanization but has undergone a spectacular twin process of intensification and diversification. The original 3 million rai of traditional (deep-water and floating) rice varieties were gradually replaced by double-cropped rice (dry-season water supply permitting), and even triple cropping has been observed in certain areas (and years). Drainage and low water levels in canals have been tapped with the use of portable individual axial pumps, as has groundwater when available. Diversification towards vegetables, flowers and fruits has met the demand of urban markets, notably on the western side of the delta irrigated from the Mae Klong.[8] Most dramatically, shrimp and fish farming have expanded in the coastal areas as well as inland. From 100,000 rai in 1994, the area devoted to fishponds expanded and peaked at around 350,000 rai in 2010 (NSO and OAE data, various years). Shrimp ponds dropped from 150,000 to 50,000 rai over the same period (mainly due to the problem of disease among black tiger prawns) but grew to around 125,000 rai over the past decade (with the spread of a new 'white prawn' variety).

The degree of mechanization and technological change in rice cultivation (most notably the shift from transplanting to direct seeding) and smaller holding sizes (from 29 rai in 1950 to 20.7 in 2013) have reduced the need for labor. This has coincided with a dramatic decline in the fertility rate (from 6.1 in the post-WWII period to 1.5 at present) and outmigration to Bangkok and its environs that have shrunk farming families (from 5.1 members in 1978 to 3.2 in 2013).

Larger farms can be found in Pathum Thani (where wealthy families bought large tracts of land during the development of Rangsit in the late nineteenth century), as well as in Ayutthaya (due to the low yield of floating rice) and Suphan Buri (with the inclusion of some upland areas) (Figure 24, left). With the diversification on smaller plots in Nakhon Pathom more than half the holdings are less than 10 rai in size (Figure 24, right) and the average farm size drops to 14 rai (Figure 25, left). Given the soil quality and availability of water in Suphan Buri, farmers are often able to triple crop their land, making it an attractive prospect, hence the high proportion of younger farmers in relation to other provinces. Indeed, in the three core rice regions of Ayutthaya, Ang Thong and Singburi, long confined to one crop of traditional varieties on part of their land, the average farmer is aged over 54 while the average family size is as low as 3 (Figure 26).

Figure 24: % of farms over 60 rai (left) and under 10 rai (right)



[8] Urban expansion has also been responsible for the destruction of orchards, both old (Thonburi) and more recent (citrus of Rangsit).

Figure 25: Evolution of average farm size in rai (left), and % of farm holders under 35 years of age (right)

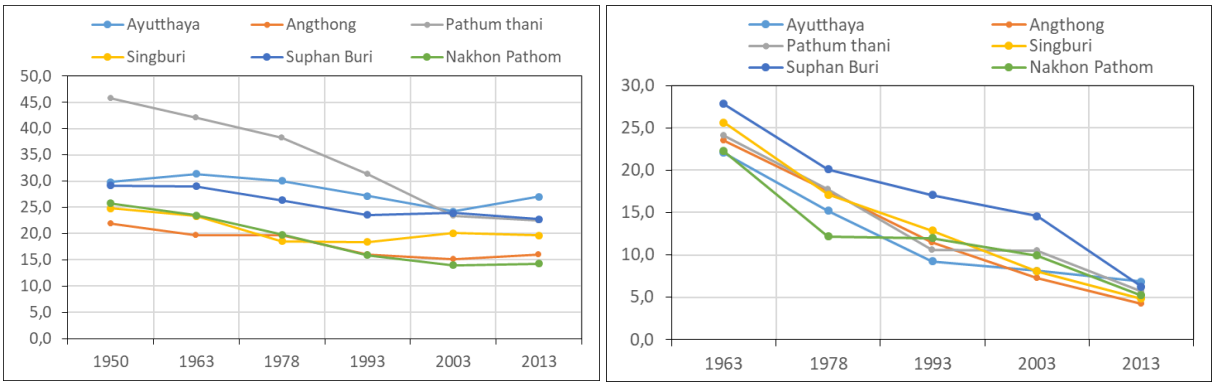
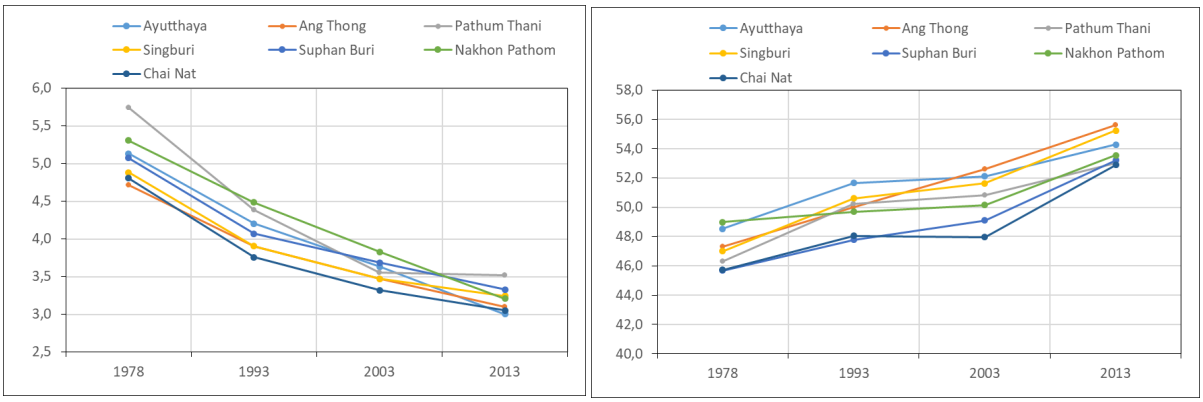
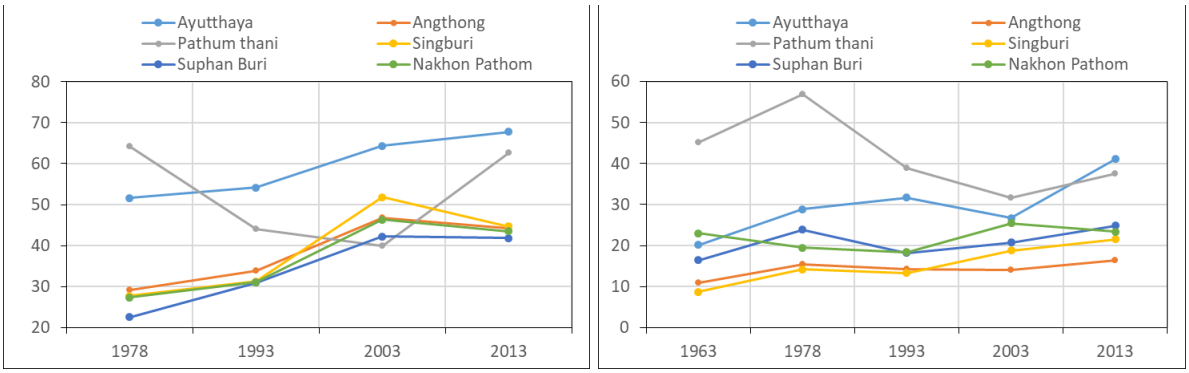


Figure 26: Average household members (left) and average age of holder (right)



The percentage of rented land has a similar trend for most jangwat: having hovered around 30% since the 1950s, it jumped to around 45% at the turn of the century before slightly decreasing (Figure 27, left). There are two major exceptions to this trend: in Ayutthaya as much as two thirds of the cultivated land is now rented – a rising trend that must be combined with the only instance (with Ang Thong) of increasing average farm size, between 2003 and 2013. This suggests that large farms are being consolidated through the renting of low-yield land released by ageing farmers.[9] In Pathum Thani the high level of tenancy is historical, as noted above (Figure 27, right).

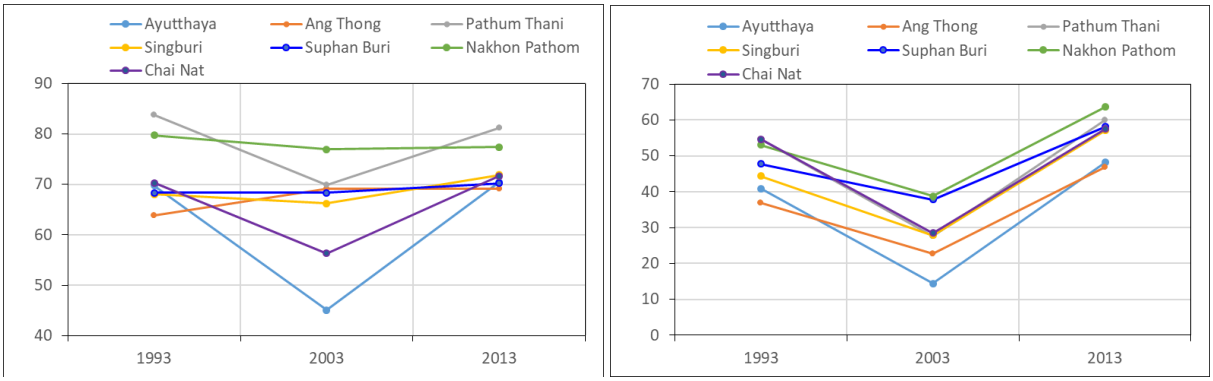
Figure 27: Evolution of the % of rented farmland (left) and full tenants (right) (by jangwat)



[9] However, since around 2010 land cultivated with traditional rice varieties has been gradually converted to double-cropping, which will probably dampen this consolidation.

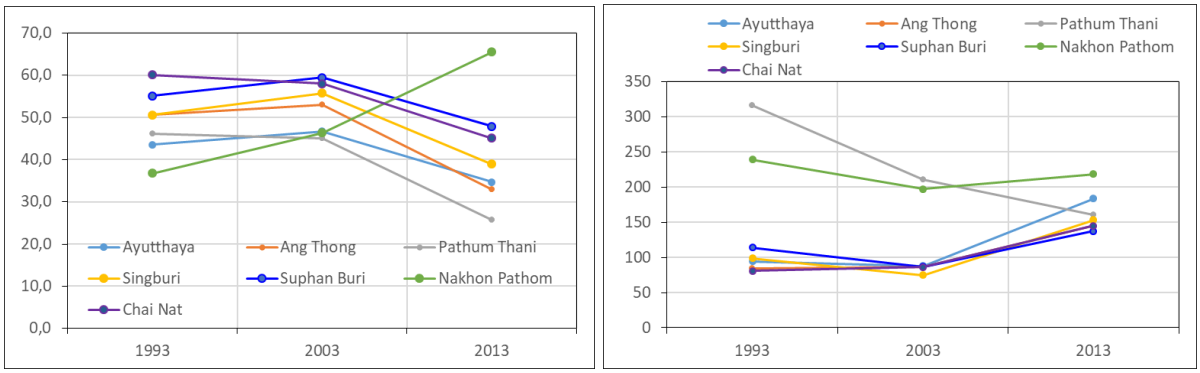
Pluriactivity – often a sign that agriculture cannot provide a sufficient income – is limited in the delta, as noted earlier. Figure 28 (left) indicates that two thirds of farms were engaged exclusively in agriculture (and almost 80% in Nakhon Pathom), with the exception of Chai Nat and Ayutthaya in 2003. The 2003 census reveals (Figure 28; right) that indeed the percentage of farmers with an income 'from agriculture only' dipped (notably in provinces with traditional rice varieties), as low rice prices severely dented the profit from rice cultivation. Data on rice farm gate prices (see appendix) show that the 1999-2001 period was an historical low and that the price in 2002 (last occurrence before the census survey) was still around that low value. One can conclude that these 3 years of depressed prices forced many farmers to supplement their income by working on other farms and in other activities. Data shown earlier (Figure 5) indicated that crop diversification away from rice reached almost a third of the total farm area. Few farmers in core rice areas could live exclusively on their agricultural activity (15% in Ayutthaya, 23% in Ang Thong). By contrast, the 2013 census was carried out in the wake of 6 years of extremely high prices, explaining that, where possible, farmers returned to rice cultivation (see chart with the evolution of rice prices in the appendix).

Figure 28: % of farms engaged exclusively in agriculture (left) and with income 'from agriculture only' (right)



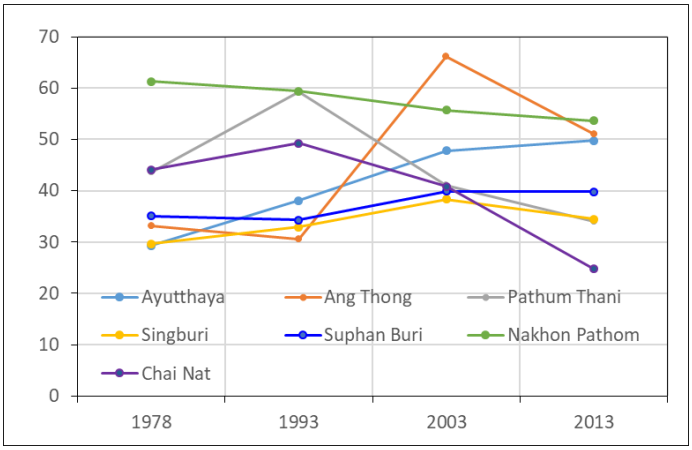
The difference in economic conditions between the 2003 and 2013 censuses is also illustrated by Figure 29 and Figure 30, which show that the percentage of indebted farmers substantially dropped after the years of high rice prices (with the exception of Nakhon Pathom[10]), and that in 2003 many farmers responded to the crisis by cutting the hiring of non-family labor (except, again, in Nakhon Pathom, where labor requirements for non-rice crops are largely unavoidable).

Figure 29: Percentage of farmers in debt (left); average farm debt (in 1000 baht, 2013 value) (right)



[10] It is unclear what caused this dramatic rise in debt, but since rice cultivation is relatively minor in this province it may be due to economic upturns in vegetable markets or aquaculture.

Figure 30: Percentage of farmers not using wage labor



4 Conclusion

The Chao Phraya Delta lies at the heart of Thailand's history of commercial rice production. In 150 years it has moved from a sparsely populated, swampy, inhospitable region to a highly urbanised and artificial environment. While productive resources such as land, labor, capital and water were initially used for agricultural (mostly rice) production, they have gradually been reallocated to other areas and economic sectors. The shift was driven by technological and population factors as well as changes in the national economy, in turn partly determined by global developments.

A defining factor of agrarian change is the intergenerational redistribution of land. In Thailand the custom is to divide it equally among male and female heirs, with the threat of a very rapid fragmentation of land holdings below economic reproduction levels, especially with a high fertility rate (6.1 children per woman on average in the post-World War II period). Several macro-level trends have combined to dramatically lessen that risk. They include:

- a sharp decrease in the fertility rate (the average number of children per woman now being well below the reproduction level);
- a sweeping absorption of excess labor first by the upland frontier and then (from the 1980s onwards) by nonagricultural sectors (both locally and through outmigration to Bangkok);
- mechanization and technological change in rice cultivation that dramatically reduced labor requirements;
- enhanced water control allowing the spread of double, and sometimes triple, rice cropping: better control of the flood regime and better access to water at the farm level (tapping of groundwater, spread of individual pumps enabling the tapping of water from drains, rivers, natural ponds and other sources).

Having gradually increased up to the end of the twentieth century, the number of farms is now subsiding. Yet, over 50 years it has actually proved to be remarkably stable. A reduction of 35% of cultivated land mainly due to urbanization has led to an overall decrease in the average farm size, which is still slightly above 20 rai. This reflects the fact that land fragmentation has stabilized at a level more or less compatible with the economic reproduction of the farm, although this average obscures opposing trends toward diversification to cash crops on smaller farms (notably in Nakhon Pathom province) and the consolidation of larger farms in the Ayutthaya/Sing Buri area. The stabilization of, or limited decrease in, the average farm size has been allowed by the reallocation of land through the rental market. This reflects in particular the fact that economic diversification has marginalized farming for a number of landholders and that ageing farmers who are no longer able to work release land to live off the rent. The eventual sale of land may also result from these two trends, especially given the

high prices fetched by land, and may provide an attractive option for older farmers with no offspring willing to take on the farm. Yet, it seems that 'land is "sticky", for legal, institutional, agro-ecological, historical, emotional and cultural reasons' (Rigg et al., 2018) and older farmers are reluctant to sell. The demise of the current generation could see the rise of a generation emotionally detached from land and farming, who would more readily release land onto the market, further fueling the transition towards land consolidation and bigger farms (ibid.).

The price of rice appeared as a defining factor in agriculture in the delta (and elsewhere in Thailand). Comparing the 2003 and 2013 agricultural censuses neatly illustrated the correlation between farming income and the allocation of labor and land. The depressed rice economy around 2003 explains the release of land onto the rental market and the surge in large farms in all jangwat. But the 2013 data show a partial reversal of this trend, which is most probably due to the high prices observed circa 2010, which made rice farming attractive again to farmers who were renting out their land (see Molle et al., 2021, forthcoming). Together with the price of rice, the desirability of rice farming – and therefore, crucially, the attractiveness of farming to younger generations (Faysse et al., 2020) – also depends on cropping intensity governed by water conditions in each area. In the floodplains traditionally limited to one crop of deep-water rice varieties, low productivity has forced the average farm size to increase to remain viable. Recent technological advances have allowed a shift to the double cropping of high-yield rice varieties, making rice farming more attractive.

In other areas, with easy access to water, double or triple cropping meant rice cultivation has been a good livelihood since the 1980s. This is particularly true of the upper West Bank in Suphan Buri province[11] and areas of the northern delta with access to shallow groundwater resources. Elsewhere, such as in the lower delta closer to urban markets, rice farmers have diversified into vegetable production or aquaculture, notably where they benefit from a secure access to water.

On balance, the development of agriculture in the Chao Phraya Delta has largely managed to avoid engendering the growth of a marginalized class of landless holdings or the excessive division or accumulation of land, having benefited from an exceptional endowment of resources, with the proximity of both consumer markets and alternative economic opportunities. Nonetheless, it now faces the new challenge of sustainability, in the form of water contamination, the overuse of pesticides, diseases in intensive shrimp farming, the increasing amount of water being used by cities or upstream of the delta, land speculation and coastal erosion.

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[11] which combines fertile land, access to dredged natural ponds, rivers and groundwater together with the political clout of its politicians with notable links to the Ministry of Agriculture.

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6 Appendix

Figure 31: Gini coefficient for the distribution of farms by class size, various censuses

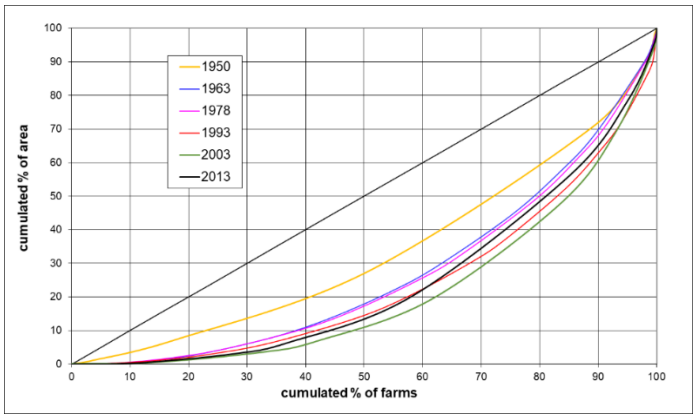

Figure 32: Evolution of farm gate rice prices

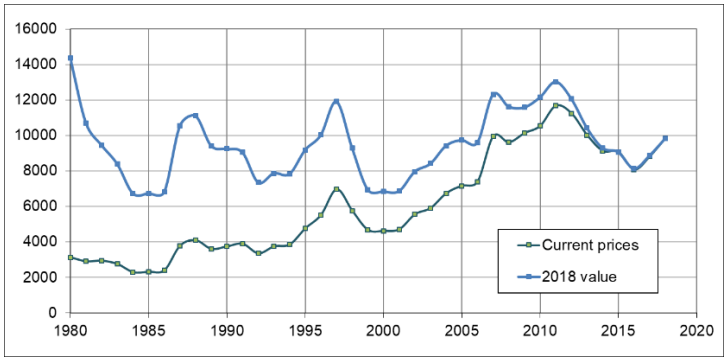

Figure 33: Rice area planted in the dry season in the Central Region (in rai)